



## Research article

## Exploring the impact of daily food habit and modification of lifestyle for boosting immunity against COVID-19

Rashni Agarwala<sup>a</sup>, Israt Jahan Maria<sup>b</sup>, Promi Dewan<sup>b</sup>, Md. Mafizur Rahman<sup>c</sup>, Zubaer Hosen<sup>d,\*\*</sup>, Md. Adnan<sup>e,f,\*</sup><sup>a</sup> Department of Pharmacy, Islamic University, Kushtia 7003, Bangladesh<sup>b</sup> Department of Pharmacy, University of Development Alternative, Dhaka 1207, Bangladesh<sup>c</sup> Department of Biotechnology and Genetic Engineering, Faculty of Biological Sciences, Islamic University, Kushtia 7003, Bangladesh<sup>d</sup> Department of Applied Nutrition and Food Technology, Islamic University, Kushtia 7003, Bangladesh<sup>e</sup> Department of Pharmacy, International Islamic University Chittagong, Chittagong 4318, Bangladesh<sup>f</sup> Department of Bio-Health Convergence, College of Biomedical Science, Kangwon National University, Chuncheon 24341, South Korea

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## ABSTRACT

The lockdown crisis due to novel coronavirus (COVID-19) mainly affected people who live under economic despair. Since boosting the immune system against the virus depends on a variety of food intake and lifestyle approaches; hence, it is crucial to know how daily food habits and lifestyle modification protect from pathogenic viral infections. This study focused on the benefit of plant-based foods, functional foods and the modified lifestyle which enhance the immunity of all aged groups against COVID-19 in Bangladesh. An online close-ended randomly selected structured multiple-choice questionnaire survey was conducted for people of different parts of Bangladesh (n = 161; male 51.55%, female 48.45%). The total percentage was counted for all variables. We found that plant-based foods, functional foods, and physical exercise played a vital role in enhancing people's immunity to control COVID-19. Plant-based micronutrients, nutraceuticals and antioxidants mainly took part to boost the immune system against the virus. Furthermore, physical activity had a vital role in improving people's immunity to manage COVID-19. Literature suggested that food habits, body immunity, awareness, stress and weight variation were affected by the COVID-19 pandemic. The vaccine or proper medication of COVID-19 still remains in an enigma. In this situation, boosting immunity to combat Coronavirus is the only way to survive.

## 1. Introduction

Coronavirus is the most up-to-date discussed issue that caused a deadly pandemic situation worldwide [1]. A similar situation was also observed during Spanish flu (1918–1919) pandemic caused by the H1N1 influenza A virus [2, 3]. However, the current pandemic has delayed regular moving processes of people globally, throwing countries into a downturn and potentially economic despair. Many developing countries are likewise suffering from severe economic shockwaves and confronted with an imbalance in the food supply due to the severity of COVID 19 [4]. In this regard, adjuvant therapies with medicinal concoctions and folk remedies floating around can contribute to longer-term solutions to this pandemic and help in managing the immediate effects. Hence, this time,

the central theme is "Boosting the Immune System", by consuming many plant-based and functional foods which may alleviate the symptoms and discomfort caused by coronavirus [5].

COVID-19 is one kind of viral disease, that attacks people with low immune systems, especially under and overages [6]. The morphological characteristics and chemical composition of COVID-19 are parallel to other humans' surrogate coronavirus [7]. To get protected from pathogenic viral infection, enhancing the body immune system is the best strategy [8]. In this regard, optimal intake of plant-based functional foods and selected nutraceuticals have been emphasized in controlling the influence of virulent strain infections [9]. Daily consumption of a considerable variety of plant, animal, fungi species, Mediterranean diets components such as olive-based products, cultural practices of traditional

\* Corresponding author.

\*\* Corresponding author.

E-mail addresses: [zubaeranftiu@gmail.com](mailto:zubaeranftiu@gmail.com) (Z. Hosen), [mdadnan1991.pharma@gmail.com](mailto:mdadnan1991.pharma@gmail.com), [mdadnan@kangwon.ac.kr](mailto:mdadnan@kangwon.ac.kr) (Md. Adnan).

herbal medicine, popular beverages such as coffee, and protein-rich foods such as chicken extract and soybean peptides can provide a protective immune system against the virus [10, 11]. Such foods contain naturally occurring micronutrients and other immune-protective phenolic compounds having potential anti-oxidant and anti-inflammatory properties [12, 13]. The immune system in the human body is enhanced by supplementation and adequate intake of functional foods [14, 15] which may provide important antiviral prevention against COVID-19 [16].

Vitamins are also necessary for the human body. Mainly, Vitamin D directly influences the antimicrobial peptide (cathelicidin) production, leading to increased resistance against virus and bacteria, and influences cytokine profiles during infection via the innate and an adaptive immune system [16]. Vitamin D helps to promote gap junction, junction of tight, and junctions of adherents (e.g., by E-cadherin). On the other hand, it partly improves innate cellular immunity by inducing 1,2,5-dihydroxy vitamin D into antimicrobial peptides like human cathelicidine, LL-37 and defensives [16].

Additionally, it is well established that physical activity and exercise play an essential role in improving the immune system [17, 18]. Physical activity is an indefensible way to prevent chronic disease related to morbidity and mortality risks [19]. Some recent studies suggested that improving cardiometabolic and respiratory functions through physical exercise boost the immune defense system for long-term mechanisms [20, 21]. Usually, physical exercise increases the potentiality of natural killer (NK) cells, neutrophils, and macrophages within both innate and adaptive immune systems. Yet, it is unclear how communicable diseases, viral infections, and the recent coronavirus can be controlled by exercise-dependent mechanisms. Although plant-based nutrients, functional foods and lifestyle modifications may not be the ultimate preventive way of contracting COVID-19 [22]; however, they could help as adjuvant therapy to decrease or alleviate the risk through enhanced immunity [23]. Therefore, this study shows crucial evidence on how plant-based functional foods and lifestyle approaches, including physical activity, can optimize immune response to viral infection, especially COVID-19.

COVID-19 pandemic has affected Bangladesh's human health, economy and food security. As a result, poor people suffer a lot because of low income and poor access to healthcare. Bangladesh is a populous country where most people live under economic stress. However, from April 2020, due to severe lockdown, food supplies and vegetable production were delayed. In addition, due to the food crisis, the price of daily commodities got up so much that poor people were unable to fulfil their daily needs. In view of all this, we aimed to study the effects of daily food habits and lifestyle modification during COVID-19 in Bangladesh.

## 2. Materials and methods

### 2.1. Data collection

We collected data randomly through an online structured multiple-choice questionnaire form. All data have been collected from May 13, 2020, to May 22, 2020. After four months, we have collected data again from September 13, 2020, to September 20, 2020. As we conducted our study during COVID-19 pandemic situation. Therefore, it was impossible to do any physical questionnaire survey.

We asked questions about 240 people. Finally, the study had been conducted among  $n = 161$  people (male 51.55%, female 48.45%), ages ranging from 18 years to 60 years. So, the attrition rate was 32.92%. We included educated, illiterate, and professionals who participated in this survey. A total of 20 questions (set in English) were set in the form with some additional questions such as socio-demographics (e.g., age, gender), and these were revised by the other members of the survey team. All the participants could complete the survey only once and submit it at any time they wished. The questionnaire form was shared with participants through social platforms, e.g., Facebook, messenger, and WhatsApp, which were accessed on personal computers, laptops,

smartphones, and tablets. The survey was completed at two quite distant time points, because the goal of our research was first to see if consumption of healthy foods and adhering to physical exercise increased immunity, and secondly if participants were affected by Covid-19. However, we discovered that only 8% of individuals were infected with coronavirus as a result of their sedentary lifestyle and poor nutrition. The study protocol was approved by both the Ethical review committee and the P&D committee of the Department of Pharmacy, Islamic University, Kushtia-7003, Bangladesh. Consent from all participants was taken before conducting the survey.

### 2.2. Data analysis

Data were analyzed by IBM SPSS 21.0 version and tabulation using a pivot table in excel. We calculated the percentage, mean and standard deviation of collected information.

## 3. Results and discussions

### 3.1. Demographic characteristics of the participants

Table 1 shows the demographic characteristics of the participants. A total of 161 respondents gave their valuable opinions to the survey. Out of 161 respondents, 83 were male, 78 were female. The major participants of the study were low-income people. No alcoholic individuals were found.

### 3.2. Availability of food items at the participants' homes

Figure 1 demonstrated the availability of food items at participants' homes. In Bangladesh, rice is the staple food, and we found significant amount (72.05%) of the staple food available at home than usual which might be because of the pandemic situation. Very few respondents (2.48%) exposed that this food item was unavailable. This percentage might result from the extreme economic consequence among the middle to poor people. It was reported that per capita income was fell by 79% in the rural area, and 82% fell for slums people within February to early April [22]. Due to this pandemic and lockdown, many people had to live without food (1.24%). From another survey by Alam GMM and Khatun MN in Bangladesh, it was reported that most of the people reduced food consumption from three times to one time per day, and most of them reduced purchasing of various types of food (fish, meat) because of the high price in the pandemic situation [24].

### 3.3. Dietary habit of the participants

The dietary habits of the participants were presented in Figure 2. Most of the participants in our study ( $n = 70$ ; 43.48%) consumed different fruits and vegetables. Generally, fresh and unprocessed foods like fruits and vegetables contain vitamins (Vit-c), minerals, dietary fibre, protein, and antioxidants are needed to boost the body's immunity. On the other hand, 20.50% of respondents did not take the immune-boosting foods. It has been reported that chickens are more susceptible to SARS coronavirus [25].

For this reason, most people started to avoid chicken and egg consumption [3]. However, only 10.56% ( $n = 17$ ) of respondents eat fish for boosting immunity. In addition, it was found that fishing activities and supplies have been reduced significantly in Asia during this pandemic [2]. The people in Bangladesh are becoming aware of coronavirus; for example, only 3.73% of respondents had eaten unhealthy sugary foods. As we know, unhealthy processed foods are high in sugar which rapidly decrease the activity of neutrophils, an essential part of the innate immune system. In contrast, carbohydrates and sugar intake develop insulin resistance, and it is more necessary not to intake for people with diabetes, heart disease, high blood pressure, and obese since they are more

**Table 1.** Demographic characteristics of the participants.

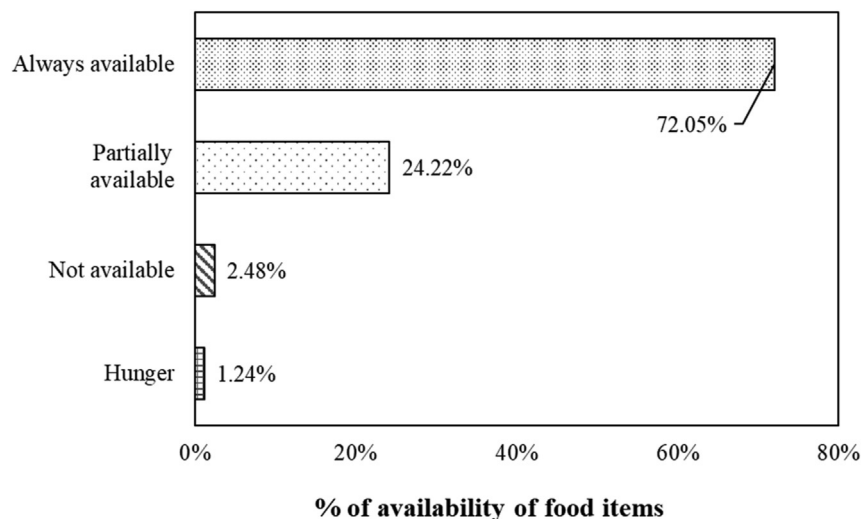
Parameters	Values
Study subjects (n)	161
Sex [n, (%)]	
Male	83 (51.6)
Female	78 (48.4)
Age (years) <sup>a</sup>	26.9 ± 6.13
Occupation [n, (%)]	
Male	
Farmers	11 (13.3)
Business	6 (7.20)
Banker	9 (10.8)
Day laborer	10 (12.0)
Doctor	1 (1.20)
Rickshaw puller	9 (10.8)
Teacher	3 (3.60)
Students	19 (22.9)
<sup>†</sup> Others	15 (18.1)
Female	
Housewives	45 (57.7)
Business	4 (5.1)
Banker	4 (5.1)
Day laborer	1 (1.3)
Doctor	4 (5.1)
Teacher	5 (6.4)
Students	9 (11.5)
<sup>‡</sup> Others	6 (7.7)
Education [n, (%)]	
No formal education	19 (11.8)
Primary	23 (14.3)
Secondary	15 (9.30)
Higher Secondary	42 (26.1)
Graduate	62 (38.5)
Income/month (US\$) <sup>a</sup>	80.5 ± 45.3
Smoking in male [n, (%)]	
Yes	41 (25.5)
No	120 (74.5)
Alcohol Intake	0.00

Data were presented as <sup>a</sup>Mean ± SD.

Abbreviation: n, Number of study subjects.

<sup>†</sup> Others included service holder, Carpenter, Driver, tailors, freelancer, security guard and retired worker.

<sup>‡</sup> others included tailors, nurse, and worker.

**Figure 1.** Availability of food items at the participants' homes (n = 161).

vulnerable to coronavirus. However, to keep a healthy diet during the COVID-19 pandemic, one needs a daily carbohydrate intake of at least 50–60% [26]. About a tiny percentage (0.62%) of respondents eat snacks and fast foods. Fast foods chains are high in sodium, saturated fats, trans fat, and cholesterol which are responsible for different diseases, especially cardiovascular diseases [27]. Moreover, 18.63% of participants drink liquids more like water or fresh foods. Drinking plenty of water or fruit juice is very important because it washes the virus from the throat. In a lockdown, people take more snacks and sugar-containing food that are very harmful to health, especially for COVID-19. In contrast to this, the percentage of drinking plenty of water is deficient, and it needs to be increased further for a healthier life. Again, there is a misconception that coronavirus can be swept out by drinking too much water. According to WHO, we should drink water every 15 min to keep our mouth and throat wet. The virus then mixes with water and wash down to the oesophagus, where it is supposed to be killed by gastric acid in the stomach with a pH value of 1–3. Nevertheless, the above idea is not entirely correct because before reaching the virus to the stomach, nostrils are more likely to be infected by the virus [28].

### 3.4. Hygiene and sanitation management of the participants

Contaminated hands are also a reason for coronavirus infection [29, 30]. So, the best approach remains avoiding contaminants and washing hands repeatedly. Our study confirmed that most participants (n = 128; 79%) washed their hands for 20 s (Figure 3). According to the Centers for Disease Control and Prevention (CDC), coronavirus can be spread from person to person or from the close contact of COVID-19 patients via respiratory droplets, but there is likely minimal risk of transmission with food or food packaging. When a person touches the surface of the contaminated food or contaminated package of food and then touches the hands in their mouth, nose or eyes, this person will be affected by COVID-19 [31]. Proper hygiene and sanitation management can prevent coronavirus [7].

### 3.5. Different cleaning agents used to clean the food items before taking or processing

In this study, 70.81% (n = 114) of the people think that viruses are present on the surface of the raw/frozen/packaged foods; 51.55% (n = 83) respondents think that virus may infect them by food or food packets; and 33.54% (n = 54) think that coronavirus can multiply in foods. Nevertheless, these are all misconceptions because there is no evidence and it is well known that COVID-19 viruses live on food surfaces or are spread by touching food, but they cannot multiply in food. Figure 4

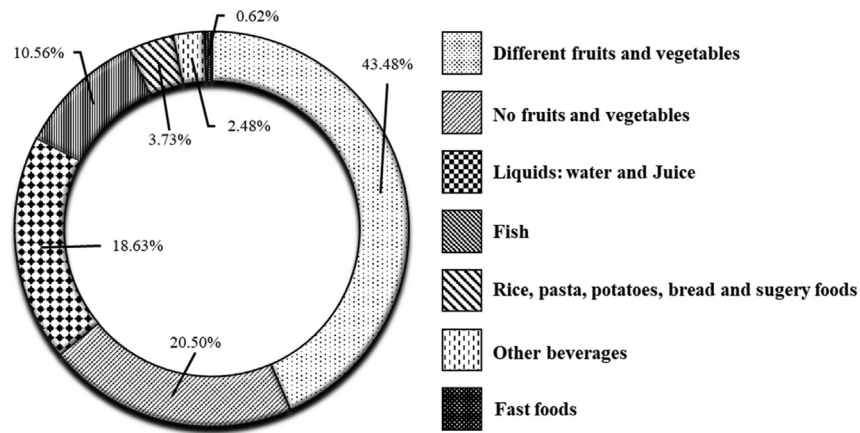


Figure 2. Dietary habit of the participants (n = 161).

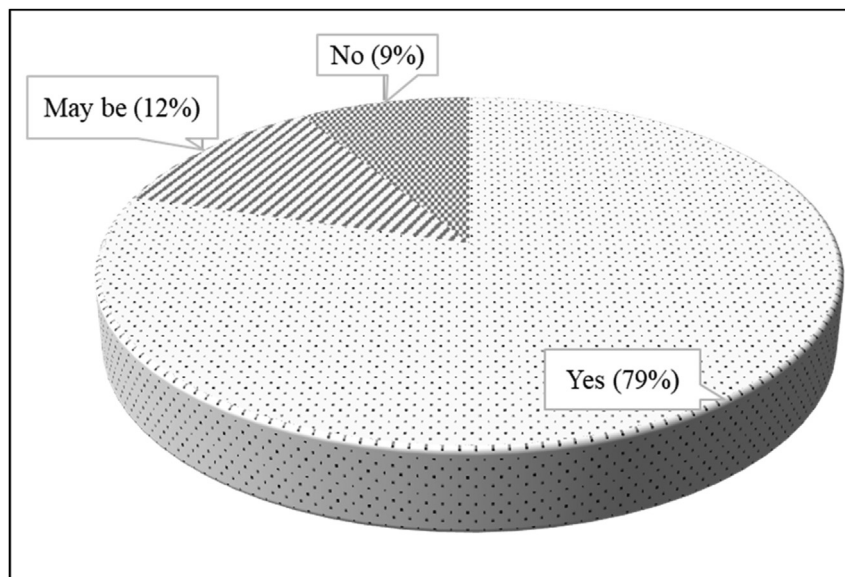


Figure 3. Hygiene and sanitation management of the participants foods (n = 161).

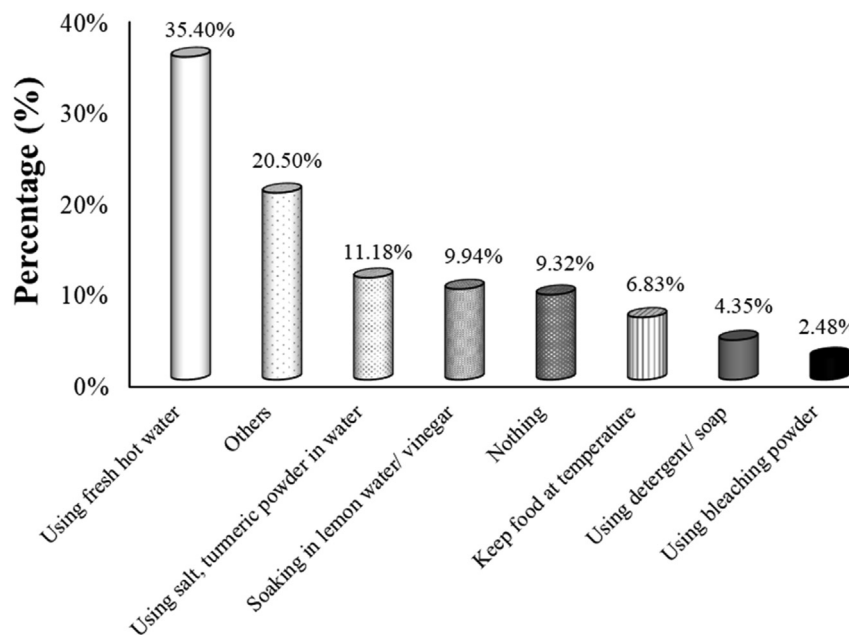


Figure 4. Different cleaning agent used to clean the food items before taking or processing (n = 161).

shows, about 90.68%, i.e., 146 respondents cleaned fruits and vegetables, and only 9.32% (n = 15) did not use an agent for cleaning. Out of 146 respondents, 35.40% of respondents washed foods thoroughly in fresh hot water, and it is the best way to clean food. Around 11.18% of food handlers use salt, turmeric powder in water, and this solution is an excellent way to get rid of most germs. There are many benefits to using the right amount of turmeric powder: reduce arthritis pain, reduce depression symptoms, contribute to treating diabetes, and boost immunity against COVID-19. Turmeric has antiviral, antibacterial, antifungal, and anti-inflammatory effects. It also acts against cough and cold, throat infection, and sinusitis [32]. The results also showed that about 16 (9.94%) respondents reported cleaning foods by soaking in lemon or vinegar water. Vinegar and lemon also wash off pesticides like-bacteria

or reduce the level of pathogens from fruits and vegetables. Data depicts that out of 146 respondents, 4.35% and 2.48% of respondents clean foods by using detergent or soap and using bleaching powder. However, it has been reported that cleaning food with any soap is harmful to health [33]. Additionally, precaution should be taken during washing foods because cross contaminations can occur [34] that can be a double threat to health in this pandemic situation [35, 36].

3.6. Physical exercise habit of the participants

Figure 5 revealed the physical exercise habit of the participants. Results exhibited that about 45% of the participants do the exercise for at least 30 min, and 15% for at least 15 min per day. About 30% of the

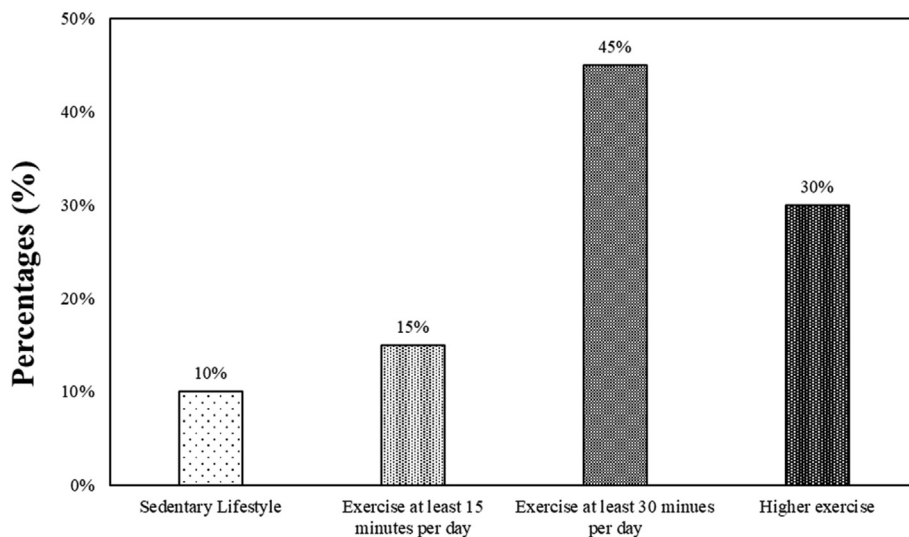


Figure 5. Physical exercise habit of the participants (n = 161).

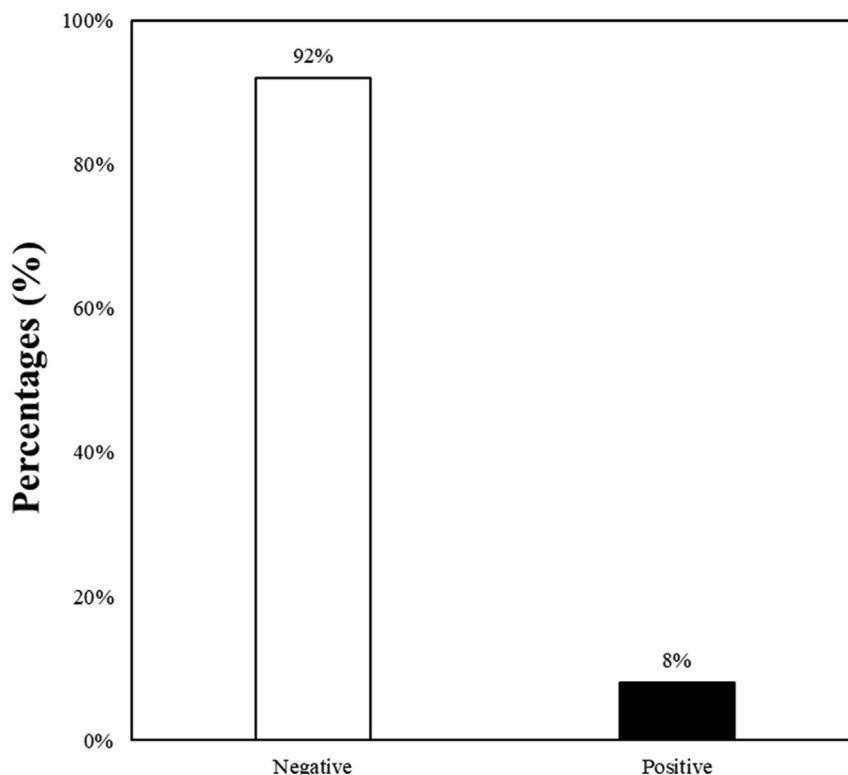


Figure 6. Percentages of COVID-19 positive patients during the follow up (n = 161).

participants are maximum day labour or rickshaw puller and they have been regarded as high exercised group. Another 10% of people lead sedentary life without exercise. Among them, 8% of people were affected by a coronavirus. The report suggested that people with a sedentary lifestyle have been susceptible to various diseases, including viral infections [37]. A survey in Italy found that a decrease in physical activity during quarantine caused various chronic diseases, such as obesity, type 2 diabetes, and hypertension, which increased the risk of coronavirus infection [38]. Therefore, everyone needs to continue exercise at home to stay healthy. In addition, moderate physical activity (20–30 min per day) have been found as beneficial for health with reducing depression and anxiety, as well as improving immune system functions [37, 39].

### 3.7. Percentages of COVID-19 positive patients during the follow-up

After four months of our first enrollment, we have collected the data again, including the COVID-19 status of our study subjects. In the follow-up study, we have found similar results to our first enrollment. On the other hand, we have found 13 participants (out of 161, about 8%) with positive corona status (Figure 6). We also cross-checked their profile and found that 10 patients lead sedentary lifestyles and dislike vegetable-based foods. It has been reported that a sedentary lifestyle can prompt various diseases, including viral infections [37, 40]. Another study suggested that sedentary behavior and poor physical activity levels are associated with obesity, diabetes, and underlying insulin resistance and oxidative stress as well as increased vulnerability to viral infections, including pandemic influenzas like H1N1 and COVID-19 [38,41].

## 4. Conclusion

The coronavirus disease (COVID-19) is a newly emerging viral infection that caused a considerable number of deaths in a short time. Scientists are trying to discover efficient vaccines to control the infection and death rate. The World Health Organization and other organizations provided different preventive ways to be safe from viral infection. Although sudden and radial changes of lifestyle (isolation and distance) due to COVID-19 lockdown affected the eating habits of the population; however, our study concluded that plant-based and functional nutrients and physical activity have a vital role in improving the immunity to manage COVID-19.

## Declarations

### Author contribution statement

Rashni Agarwala: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Israt Jahan Maria: Performed the experiments; Analyzed and interpreted the data.

Promi Dewan: Analyzed and interpreted the data.

Mafizur Rahman: Conceived and designed the experiments; Wrote the paper.

Zubaer Hosen: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Adnan: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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### Data availability statement

Data included in article/supplementary material/referenced in article.

## Declaration of interests statement

The authors declare no conflict of interest.

## Additional information

No additional information is available for this paper.

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